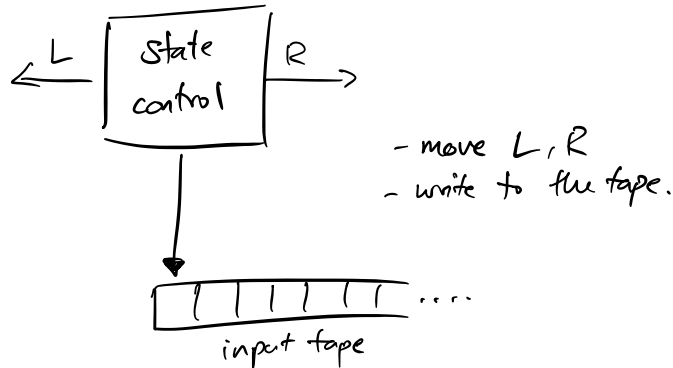


Turing Machines

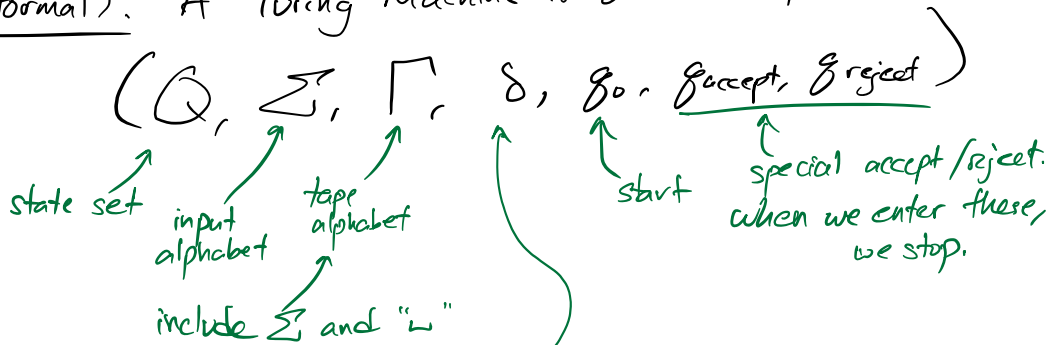
Sipser 165-169 and 174



At each step:

- (1) read input symbol
- (2) change internal state
- (3) write on the tape
- (4) move L or R

TM (formal). A Turing Machine is a 7-tuple:

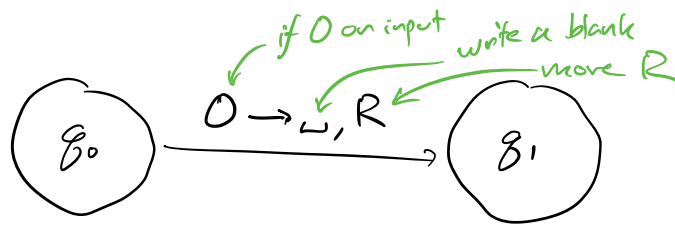


transition function

$$\delta : \underline{Q \times \Gamma} \longrightarrow \underline{Q \times \Gamma \times \{L, R\}}$$

"give me an internal state and a tape symbol"

"I'll tell you a new internal state, a tape symbol to write, and whether to move L or R."



Higher level description:

implementation-level description: describe the tape head movement and the tape contents (read/write).

$$C = \{a^i b^j c^k \mid i \times j = k \text{ and } i, j, k \geq 1\}$$

$M_3 =$ "On input string w :

1. Scan the tape and make sure input matches $a^+ b^+ c^+$.
2. Move back to left. For each a :
 - cross off the a
 - shuttle back and forth, between b 's and c 's, crossing off a c for each b until no b 's remain.
 - ⊕ - if I run out of c 's, reject
 - restore the crossed off b 's.
3. If all a 's are crossed off, accept if no c 's remain reject otherwise."

test strings:

(1)	aa bbb cccccc	✓
(2)	aa bbb <u>cccccc</u>	✗
(3)	aa bbb cccccc c	✗

TM recognizes a language if it accepts all and only strings in the language.

TM decides a language if it accepts all in the language and rejects otherwise.